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On the WWW, such overloading can be extremely detrimental. As web browsers have become the primary interface for access to many network and server services, more businesses have begun using the WWW to market their products or for advertising purposes. To these businesses,

robin DNS performs load balancing by routing requests to these servers in sequential rotation based on their IP addresses.

When a web site has several servers operating under the same URL, those extra servers are often called "proxy" or "mirror" servers. The proxy server stores exactly the same web site information found in the originating server. Thus, when a user makes a request to visit a website that uses a proxy server, the user will see the same exact website whether or not the user is visiting the proxy server or the original server.

As the need for proxy services has increased, some companies have begun to operate their own proxy networks for the purpose of delivering content for certain subscriber WWW sites. However, the agreements these proxy network providers have with the subscriber WWW sites is generally long-term in nature. Thus, the proxy networks are generally configured for the maximum expected traffic at the subscribed WWW sites and there is often unused capacity on the proxy network being wasted. What is needed is a method to let the proxy network dynamically sell the extra capacity so that it is not wasted.

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Summary

5 The system and method is directed to dynamic proxy
reconfiguration implemented in interconnected network
servers. In particular, the invention is directed to a
computer-executable program for use in proxy network
servers which enables each proxy server to dynamically sell
its unused capacity to other web sites for specific periods
10 of time. The invention has particular utility in
connection with World Wide Web servers and proxy servers,
but can be used with other servers where proxy servers may
be present, such as CORBA servers, ORB servers, FTP
servers, SMTP servers, and Java servers. The system and
15 method may be used to dynamically sell extra capacity to
other websites to make additional profit.

In a preferred embodiment, a proxy server network
monitors its servers to determine whether any unused
capacity exists. If any unused capacity exists, the proxy
20 server can sell an estimated or set amount of unused
capacity for a set amount of time through various market
mechanisms to web site server operators.

Once a purchaser has been identified, a controller
program either on the domain name server of the proxy

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network or on a separate server connected to the proxy
server network ensures that the proxy network's domain name
server receives information on the purchaser website. This
information includes the name to address map of the
5 purchaser web site network and the content of those
websites which will be stored for the purchased period of
time on the proxy servers.

After this information is stored on the domain name
server of the proxy server network, the domain name server
10 of the proxy server network can begin mapping a fraction of
the overall mapping requests to the proxy servers. The
overall fraction of requests mapped by the domain name
server will depend on the initial agreement between the
proxy network and the purchaser. For example, if the
15 unused proxy capacity was determined based on an estimate
of extra capacity available, the proxy network might
service the purchaser website's mapping requests using its
best efforts for the time its agreed to provide proxy
server capacity to the purchaser. In such a case, the
20 final bill due the proxy server network will be based on
the purchaser website's actual usage of the proxy server
capacity.

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The remaining fraction of mapping requests which the proxy server network does not handle are routed back to the purchaser website's servers for mapping. However, if the purchaser supplied the controller program with an assignment algorithm, the domain name server of the proxy server network will route the remaining mapping requests to servers in the purchaser website's network.

Brief Description of the Drawings

Figure 1 is a hardware diagram illustrating the data flow of the preferred embodiment for the system and method to let a proxy network dynamically sell unused capacity.

Figure 2 is a hardware diagram illustrating the data flow of an alternative embodiment for the system and method to let a proxy network dynamically sell unused capacity.

Figure 3 is a block diagram illustrating a typical path taken by a user's request for a particular address on the internet, and the path taken in receiving that address.

Figures 4-8 are flowcharts illustrating embodiments of the system and method to let a proxy network dynamically sell unused capacity.

Detailed Description of the Preferred Embodiments

The system and method is directed to reconfiguring proxy network servers so that proxy networks can

5 dynamically sell unused capacity to other networks for specific periods of time. This unused capacity can be used for delivering content normally found on the purchaser's network, so that the overall load on the purchaser network is reduced. Although the system and method will be
10 described in the context of the WWW, and more specifically the content of WWW servers, it is not limited to use in this context. Rather, the system and method can be used in a variety of different types of networking systems with a variety of different servers. For example, the system and
15 method can be used in intranets and local area networks, and with CORBA servers, ORB servers, FTP servers, SMTP servers, and Java servers, to name a few.

Fig. 1 is a basic hardware diagram of a networking system capable of carrying out the processing in accordance
20 to one embodiment of the system and method. More specifically, Fig. 1 depicts the topology of a website network and proxy network and how they connect to the internet and to each other. Fig. 1 shows a proxy network's

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connections to the internet consisting of a proxy network server cluster 5, a packet filter 4, a local domain name server of the proxy server network which contains a controller program 3, and a router for the proxy network 2 to connect to the internet 1. A similar set of hardware components exists for a purchaser web site server cluster 9 to connect to the internet 1. A brief description of this hardware is provided below.

Router 2 receives requests for information stored on the proxy network server cluster 5 from a remote location via the internet 1. Router 2 routes these requests, which typically comprise URL's, to the local domain name server of the proxy server network 3. The local domain name server of the proxy network 3 receives a URL from router 2 and resolves the domain name in the URL to a specific IP address in proxy server cluster 5.

Router 6 and local domain name server 7 perform the same tasks as Router 2 and domain name server 3, except that they are routing requests to a purchaser web site server cluster 9.

Packet filters 4 and 8 are generally found in most networks and serve as firewalls for the internal networks

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consisting of proxy network server cluster 5 and purchaser
web site server cluster 9 respectively. All transactions
into and out of an internal network are handled by the
network's packet filter. Packet filters determine which
5 services of the internal network may be accessed from the
internet 1, which clients are permitted access to those
services, and which outside services may be accessed by
anyone on the internal network. Thus, packet filters 4 and
8 analyze data packets passing through them and filter
10 those packets according to the settings on each network,
restricting access where necessary and allowing access
where appropriate.

The proxy network server cluster 5 and the purchaser
web site server cluster 9 are both internal networks which
15 are typically comprised of multiple servers. Sometimes
these servers are all connected through a mainframe (or
similar computer). The servers that make up each server
cluster 5 and 9 are used to store files, such as website
files, so that users may later access and view the files.

20 Fig. 2 illustrates an alternate embodiment to the
hardware structure depicted in Fig. 1. In Fig. 2, instead
of storing the controller program on the local domain name

server of the proxy network 3, the controller program is located on its own server 10 which is connected to the local domain name server 11.

Fig. 3 is a hardware diagram depicting the general path taken by a user's request for a particular address on the internet, and the path taken in receiving that address used in the prior art. A user 50 using a web browser requests a web site address using a URL. The URL is then sent to a local domain name server 51 on the user's 50 own local network. Domain name servers are responsible for resolving uniform resource locators or "URLs" (e.g., "www.foo.com") to specific internet or internet provider ("IP") addresses (e.g., 111.222.111.222). If the user 50 is requesting an address on the local network, the local domain name server 51 will have the corresponding internet address and will relay the internet address back to the user 50. The web browser of the user 50 will then take the user 50 directly to the requested site.

Otherwise, if the user 50 is not requesting a URL which corresponds to an IP address on the local network, the local domain name server 51 will not have corresponding IP address and the local domain name server 51 will have to

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contact a root domain name server 52 to get the
information. If the root domain name server 52 does not
have the IP address corresponding to the URL submitted by
the user 50, then various minor domain name servers 53 and
5 54 will have to be contacted. If the minor domain name
servers 53 and 54 don't have the internet address, the
local domain name server 55 of the network 56 the user is
contacting will be contacted to provide the IP address.
However, often the minor domain name servers 53 and 54 will
10 have the IP address to the URL requested by the user, and
the local domain name server 55 of the network that the
user is contacting will not have to be contacted.

Fig. 4 illustrates the initial process steps of the
present invention for dynamically reconfiguring a proxy
15 network to sell extra capacity to other networks,
specifically WWW server networks. To begin, in steps 100
and 101 a determination must be made as to whether any
unused proxy server capacity actually exists for a period
of time which could be marketed to a web site operator.
20 This determination can be made by a proxy network operator
or by the controller program monitoring the proxy server
network. The controller program is stored either on its

own server 10 connected to the proxy server network, or on the local domain name server of the proxy server network 3.

Once it is determined that some unused proxy server capacity is available, step 102 follows where the unused proxy server capacity is marketed through various mechanisms known to persons skilled in the art. Some of the various ways in which the unused proxy server capacity can be marketed includes, but is not limited to, online auctions on the internet or on real-time continuous markets which are accessible via the internet. The unused proxy server capacity can also be sold either as an estimate (i.e., the proxy server network will use its best efforts to provide the capacity being sold and will possibly even supply additional capacity if it becomes available at a predetermined rate) or for a specific amount. In either case, the unused proxy server capacity will be sold to a purchaser for a limited, set time (i.e., the proxy server network will accept purchaser website's requests for four hours or for four hours on a daily basis). Payment for the purchase of proxy server capacity can be made through various mechanisms known to persons skilled in the art.

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For example, a credit card could be used or money could be wired from a specific account.

If some unused proxy server capacity is sold, step 103 then follows where the controller on the proxy server

5 network is notified about the sale. Purchaser information is then sent to the controller in step 200 in Fig. 5. Such information includes, but is not restricted to, the purchaser's billing information such as credit card information, billing address, etc..

10 In step 201, the controller program ensures that the local domain name server of the proxy network is the primary domain name server, which is the only domain name server that can assign names to the proxy servers. As illustrated in Fig. 3, a user 50 who requests a website
15 using a URL must have the URL mapped to a numerical IP address before accessing the actual website. However, often the user 50 does not have to contact the local domain name server of the network to get the IP address which corresponds to the URL the user 50 is requesting. In such
20 cases, other minor domain name servers 53 and 54, which are outside the network, are able to provide the user 50 with the requested IP address. Step 201 ensures that local

domain name server of the proxy network 55 will serve all
naming requests. Therefore, the root domain name server 52
and minor domain name servers 53 and 54 will not be able to
provide the user 50 with any name to address translations
5 for the proxy server network. In this fashion, only the
local domain name server 55 will have to be updated when
proxy server network dynamically provides unused capacity.

In step 202, the primary domain name server receives
the name to address map of the purchaser web site and
10 routes copies of the purchaser's website content to servers
on the proxy network. Therefore, the primary domain name
server 3 handles all name to address translation requests
for the purchaser website for the time that the purchaser
has paid to use the proxy server capacity. The name to
15 address map of the purchaser website can be obtained by the
primary domain name server from the purchaser website's
local domain name server. In addition it could be sent to
the primary domain name server by a purchaser website
operator along with an assignment algorithm or other
20 mapping information the purchaser would like the proxy
server network to know. The controller program would

ensure that the information is received and handled appropriately.

In step 203, the controller program determines how to handle the mapping requests to the purchaser's website by
5 examining whether or not the unused proxy capacity was purchased based on an estimate of usage. For example, if the original sale of the proxy server capacity was based on an estimate of unused capacity available, or if purchaser just wanted to purchase whatever unused proxy capacity
10 existed, the controller program will have to initiate a steps 204 and 205 to route the mapping requests for the purchaser.

In step 204, the primary domain name server routes a fraction of the overall mapping requests for the purchaser
15 website to servers in the proxy network based on the amount of unused proxy capacity available. In step 205, the primary domain name server monitors the load levels on the proxy servers to adjust the fraction of mapping requests for the purchaser website routed to proxy servers based on
20 the amount of unused capacity available at any given time. This ensures that the proxy server network is never overburdened by the number of requests to the purchaser

website. Thus, the dynamic sale of proxy capacity to other networks never interferes with the other operations of the proxy server network.

In step 206, the primary domain name server determines
5 whether there are any mapping requests that cannot be
routed to the proxy server due to a lack of proxy server
capacity. If there are some, the primary domain name
server next checks to see if the purchaser of the proxy
capacity provided an assignment algorithm for handling
10 these requests in step 300 in Fig. 6. If an assignment
algorithm was provided, the primary domain name server
routes all the mapping requests that the proxy network
cannot handle to servers in the purchaser website's network
in step 301. Otherwise, if an assignment algorithm was not
15 provided, step 302 ensures that those mapping requests are
returned to the domain name server of the purchaser
website's network.

At this point, the controller program determines in
step 500 in Fig. 8 whether the purchaser's period of time
20 for using capacity on the proxy server network has expired.
If it hasn't, the primary domain name server continues to
map requests for the purchaser website. Otherwise, in step

